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Malnutrition of children in Sikasso (Mali): Prevalence and socio-economic determinants

Summary

Background: *Malnutrition of children is a major public health problem in many African countries. Despite a relatively favourable geographical situation, the prevalence of malnutrition is high in the Sikasso region (Mali).*

Methods: *Survey repeated annually during 5 years, to a sample of 491 families living in Sikasso. The determinants of wasting and stunting were analysed using logistic regression.*

Results: *The prevalence of stunting was about 25%. Prevalence of wasting was about 12%, which is very high, and had been increasing in the past years. No strong associations with socio-economic factors were observed for wasting. Stunting was strongly associated with the education level of both parents, and with the family assets.*

Children malnutrition is an endemic problem in many regions of West Africa, and one of the major public health problems in this continent. Its causes are complex and include not only poverty, but also lack of availability of food, or inappropriate knowledge of adequate feeding for the toddler[1]. Because of its relatively favourable climatic situation and its agricultural resources, the region of Sikasso, in the south of Mali, has long been considered a relatively privileged area in this respect, where malnutrition was not an important public health problem. However, the 1987 Demographic and Health Survey showed that prevalence rates of children malnutrition in this area were higher than those in the middle regions of Mali, and compared to those found in the northern, sahelian regions of the country, where drought and food availability are a much more important problem[2].

Sikasso is the capital city of the third administrative region of Mali. In 1986, a programme for the promotion of mother and child health (the *Sikasso MCH project*) started there, under the auspices of the Swiss and Malian branches of the association *Mother and Child International (MCI)*, sponsored by the CIBA-GEIGY Foundation, Basle. The two main components of the project were the development of services and programmes for the promotion of mother's and child's health (the *Sikasso MCH project*), and the epidemiological evaluation of their impact on behaviours, health and mortality (the *Sikasso Study*). A first MCH centre was set up in 1987, followed in the following years by the equipment of five others. These structures and their staff are fully integrated in the national health care system; as such, they are part of the District Health Care Service (Centre de santé de Cercle), which is in charge of their management.

The Sikasso Study is a longitudinal study of a random sample of the families of Sikasso, which was undertaken to evaluate the MCH project, and to help in the planning of health services and in the understanding of the determinants of health, mortality and health-related behaviours.

The objectives of this paper are to describe the prevalence of malnutrition in children under five years of age, and to assess the effect of some socio-economic determinants of children malnutrition.

Subjects and methods

The *Sikasso study* is a longitudinal, multi-rounds study. A random sample of 491 families (11% of the

total number of families) living in Sikasso municipality was drawn from the administrative census of 1986. The Sikasso municipality comprises the city of Sikasso, including the peripheral quarters, and the historical centre of the town, today a village located 8 kilometres from Sikasso City (the village of Bougoula-Hameau).

The criteria for inclusion to the study were as follows: the family had to comprise at least one woman under 50 years of age, or at least one child under 5 years of age, at the time of the first visit. At each subsequent annual survey rounds staged between April 1988 and September 1993, a questionnaire was completed for the head of the family, for all the women, and for all the children under five at the time of the first visit or who were born since. A team of trained and experienced interviewers, working full time for this project, collected data about the following items: social and demographic data, attendance for antenatal care, childbirth, family planning, knowledge about immunisation, oral rehydration and family planning methods, utilisation of immunisation and other health promotion services, utilisation of health care services in case of disease, health status of the child, and child survival and mortality.

The nutritional status of 0 to 5 years old children was assessed at annual intervals, at each successive round. Weight was measured in the field with a Salter-type portable scale, and length (under 1 year) or height with a portable toise.

Anthropometric indices, corresponding to the child's age and sex, and based on the US National Centre for Health Statistics (NCHS) reference[3], were computed using the ANTHRO Software[4]. According to the classification of Waterlow[5] and the recommendations of WHO[6], indices of malnutrition were expressed as standard deviation scores of the standard (Z-scores), below a cut-off level of –2 SD. There were defined as follows: wasting: weight-for-height (WFH) Z-score <–2; stunting: height-for-age (HFA) Z-score <–2; and underweight: weight for age (WFA) Z-score <–2.

Two series of analyses are presented here. Firstly, prevalence rates of malnutrition, for each indicator, by age, by sex, and globally, for each survey round (Table 2). In this analyse, prevalence rates of underweight have been included for comparison purpose, because it is a widely used indicator[7]. However, this indicator was not examined in subsequent analyses, because it reflects a combination of wasting and stunting.

Secondly, determinants of wasting or stunting were analysed using logistic regression of the various socio-economic variables, taken individually (Table 3). In this analysis, we used a simple conceptual framework where the health variable (wasting or stunting) is seen as depending from determinants at the societal level, mainly socio-economic factors. Age and sex of the child are considered as background variables. As there were, as expected, strong variations of prevalence of malnutrition with age, and as the determinants of malnutrition were possibly different at different ages, analyses were performed separately for each age group. Sex was not shown to be a determinant of malnutrition, and therefore was not considered in subsequent analyses. Socio-economic variables included in the analyses were: the ethnic group of parents, their level of education and occupation, household assets, water supply to the house, connection to electricity, type of house and means of transportation. A description of the variables used in given in Table 1.

In order to optimise the available information, data of the 5 different surveys rounds were pooled together for the analyses of the determinants of malnutrition. Because the data were analysed for each age group separately, and because the survey rounds were separated by one year intervals, every child could appear in various age groups, but appeared only once in each group.

In a third step, logistic regressions were performed on the prevalence of malnutrition with multiple explanatory variables and their interactions.

For estimation of effects in logistic regression analyses, a statistical level of 0.1 was accepted as significant[8]. Statistical analyses were performed with the SAS STAT software.

Results

Prevalence of malnutrition

As Table 2 shows, prevalence of stunting was, all ages and sexes together, 27.2% at the first round, and 23.2% at the fifth round, with no significant variations between the yearly rounds. On the contrary, prevalence of wasting was 6.5% on the first round, and 12.5% on the fifth, after reaching a peak at 17.9% on the fourth round. These differences were statistically significant ($p<0.001$).

The prevalence of wasting was lower in the first year, peaked during the second year, and again was lower during the third to fifth years age. On the other side, the prevalence rate of stunting was lower in the first year of age, it peaked during the second year, and plateaued thereafter during the third to the fifth year. There were no statistically significant differences of malnutrition prevalence between sexes.

Socio-economic determinants of malnutrition

Analyses of the socio-economic determinants of wasting showed only a few associations, and with

Variable	Description and categories
Dependant variables:	
Malnutrition:	
Wasting: Weight for height: (WFH)	0: Normal (≥ –2 SD)
Stunting: Height for age (HFA)	1: Malnourished (< –2 SD)
Underweight: Weight for age (WFA)	
Child's characteristics:	
Age (years)	0: 0–11 months
	1: 12–23 months
	2: 23–35 months
	3: 36–47 months
	4: 48–59 months
Sex	1: Male
	2: Female
Socio-economic variables:	
Ethnic group	1: Bambara
	2: Senoufo, Minianka
	3: Peuhl
	4: Others (incl. Tamashek, Bobo)
Level of education (father or mother)	1: Low: No formal schooling
	2: Intermediate: Primary school, professional training
	3: High: Secondary school, superior studies
Occupation (father or mother)	Group I: Unemployed, skilled or unskilled worker
	Group II: Small business; monthly salary
Household equipment	1: None of the following
	2: Improved fireplace
	3: Radio
	4: TV or frigo or refrigerator
Water supply	1: None, or unprotected well
	2: Protected well
	3: Tab
Electricity	0: No
	1: Yes: Connected to the network, or own supply
Type of house	0: Earth
	1: Some concrete blocks
	2: Concrete
Means of transport	0: None
	1: Bicycle, cart
	2: Motorized bike
	3: Motorbike, car

Table 1. *Definitions of variables used in analysis.*

		AGE (years) 0	1	2	3	4	SEX Male	Female	ALL
Observations									
Round 1	N	114	102	116	125	121	294	284	578
Round 2	N	133	139	135	144	156	361	346	707
Round 3	N	128	126	122	133	141	335	315	650
Round 4	N	104	113	115	116	123	293	278	571
Round 5	N	87	99	114	107	110	266	251	517
Stunting									
Round 1	%	14.9	38.2	23.3	32.8	27.3	28.6	25.7	27.2
Round 2	%	10.5	39.6	30.4	22.9	24.4	25.8	25.4	25.6
Round 3	%	14.8	37.3	27.0	27.1	19.1	24.8	25.1	24.9
Round 4	%	12.5	34.5	32.2	19.8	25.2	23.5	26.6	25.0
Round 5	%	17.2	31.3	25.4	23.4	20.0	25.2	21.9	23.6
Wasting									
Round 1	%	6.7	9.4	7.1	4.0	5.8	6.2	6.8	6.5
Round 2	%	3.1	15.7	4.5	1.4	2.5	7.2	3.4	5.4
Round 3	%	7.5	24.8	9.8	9.0	7.1	11.7	11.3	11.5
Round 4	%	16.0	29.8	19.0	12.8	12.3	21.2	14.4	17.9
Round 5	%	10.5	18.2	13.2	8.0	12.7	14.0	10.8	12.5
Underweight									
Round 1	%	11.3	26.6	19.8	25.4	22.3	21.5	20.7	21.1
Round 2	%	9.2	38.6	22.8	11.0	16.1	20.6	18.3	19.5
Round 3	%	14.2	41.3	35.2	20.1	17.0	26.8	23.6	25.2
Round 4	%	17.3	45.1	38.3	25.6	26.0	31.6	29.7	30.7
Round 5	%	24.7	38.4	32.5	23.2	21.6	30.4	25.5	28.0

Table 2. *Prevalence of wasting, stunting and underweight; by age, by sex and total, at each annual study round.*

relatively small effects (data not shown). By opposition, stunting showed some strong associations with socio-economic determinants, which are summarised in Table 3.

Ethnic group

Prevalence of stunting malnutrition was highest in the Senoufo/ Minianka ethnic group. This group, which is the most represented in the population of Sikasso, is composed of an important proportion of peasants. On the other hand, many civil servants are from the Bambara group.

Parental level of education

There was a strong negative association between parent's education and stunting. The association appeared to be slightly stronger for education of father's than mother's. However, multivariate analyses including both variables led to the conclusion that both effects were significant and in part independent from each other.

Parental occupation

Prevalence of stunting was lower in children whose father or mother belongs to higher professional groups. However, parent's occupation was strongly associated with their level of education. Multiple logistic regression models showed that association between occupation and stunting was almost entirely accounted for by parent's level of education.

Household assets

There were strong negative associations between stunting and the family possessions, an indicator of the economic situation of the family. In multiple regression models, the effects of father's education, mother's education and

	AGE														
	0			1			2			3			4		
Determinant:	**N**	**%**	**p**	**N**	**%**	**p**	**N**	**%**	**p**	**N**	**%**	**p**	**N**	**%**	**p**
Father's ethnic group			ns			*			****			ns			ns
Senoufo/Minianka	194	11.9		236	41.1		237	36.3		250	26.0		242	24.4	
Bambara	46	15.2		61	31.1		60	23.3	**	67	23.9		70	22.9	
Peuhl	26	23.1		36	41.7		38	26.3		45	26.7		41	20.2	
"Others"	82	12.2		91	27.5	**	99	14.1	****	106	17.0		104	20.2	
Mother's ethnic group			ns			**			****			*			ns
Senoufo/Minianka	184	12.0		237	41.3		231	37.2		239	28.0		259	26.2	
Bambara	57	17.5		58	25.9	**	63	19.0	***	73	15.1	**	68	19.1	
Peuhl	35	17.1		49	38.8		43	23.3	*	54	18.5		53	17.0	
"Others"	78	12.8		85	28.2	**	105	18.1	****	107	20.6		96	22.9	
Father's level of education			*			***			**			**			*
Low	202	14.4		250	40.8		242	37.2		257	29.6		266	25.9	
Intermediate	83	14.5		102	32.3		103	18.4	***	115	17.4	**	109	19.3	
High	35	2.9	*	42	19.0	***	45	17.8	**	49	14.3	*	49	14.3	*
Mother's level of education			ns			*			*			***			*
Low	252	13.5		307	39.4		323	32.2		335	27.5		341	26.4	
Intermediate	97	13.4		114	31.6	4	113	19.5	**	125	15.2	***	120	17.5	*
High	7	14.3		12	16.7		11	18.2		17	5.9	*	17	11.8	
Father's profession:			ns			***			***			ns			ns
Group I	238	14.3		295	40.0		283	35.3		301	26.9		312	23.1	
Group II	79	10.1		97	25.8	**	105	16.2	***	117	18.8		110	22.7	
Mother's profession:			ns			ns			*			***			*
Group I	342	13.4		412	37.1		425	29.4		447	24.8		449	24.5	
Group II	14	14.3		21	28.6		22	13.4		30	3.3	**	29	10.3	
Household equipment:			ns			ns			**			***			***
Nothing	39	23.1		34	50.0		40	32.5		35	25.7		47	36.2	
Improved firebox	48	8.3		55	40.0		60	25.0		60	31.7		59	30.5	
Radio	239	13.4		304	35.9		308	31.2		329	24.9		326	23.0	*
TV/video/refrigerator	30	10.0		40	27.5		39	10.3	**	53	3.8	***	46	6.5	***
Water supply:			ns			**			***			ns			ns
Nothing or unprotected well	88	17.0		98	20.0		107	43.0		96	29.2		109	25.7	
Protected well	230	11.7		287	33.1	***	292	24.3	****	324	22.8		313	24.6	
Tab	38	15.8		48	31.2	**	48	22.9	**	57	17.5		56	14.3	
Electricity			ns			ns			*			***			***
Without	302	13.9		365	38.1		374	30.5		391	26.6		396	26.0	
With	54	11.1		68	29.4		72	19.4	*	86	9.3	***	82	12.2	***
House building material			ns			****			**			***			***
Rammed earth	131	14.5		149	48.3		143	36.4		160	33.1		160	31.2	
In semi-concreted	139	14.4		176	33.5	***	186	28.0		184	22.8	**	180	22.2	*
In concreted	86	10.5		108	25.9	****	117	20.5	***	133	12.8	****	138	16.7	***
Means of transportation:			ns			***			****			***			***
Nothing	44	22.7		53	39.6		65	24.6		70	25.7		71	29.6	
Bike/cart	67	14.9		79	46.8		70	45.7	**	85	37.6		87	35.6	
Moped	178	11.2		217	38.2		218	30.7		224	21.4		221	21.3	
Motorbike/car	67	11.9		84	21.4	**	94	13.8	*	98	14.3	*	99	14.1	**

N: number of observations; %: proportion of malnourished; p: p-value of chi-square for covariates (–2LL); when –2LL p-value is lower than 0.1, significant Wald-chi square test p-values, for the comparison of each category of the variable relative to the first one, are indicated. NS = not statistically significant; * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$; **** = $p < 0.001$

Table 3. *Socio-economic determinants of stunting malnutrition, by age groups.*

household assets all remained significant.

Water supply

Strong associations were observed between stunting and lack of a proper access to water, particularly in the age groups 1 and 2 years. These effects remained statistically significant after controlling for father and mother education.

Connection to electricity

There was a negative association between house connection to electricity and stunting malnutrition. This effect remained after controlling for father and mother education, in children 3 to 5 years.

Construction materials of the dwelling

Children living in house built in concreted material had lower rates of stunting. This effect remained significant after control for parent's education.

Means of transportation

Prevalence of stunting malnutrition was lower in children whose parents owned a motorised means of transport. This association was present in all age groups after the first year, and remained after control for the level of parents education.

Discussion

This study confirms the presence of high rates of prevalence of malnutrition the children of Sikasso, particularly during the second year of life.
Wasting rates are particularly appalling compared to other countries from the South. The following figures come from a review of the median prevalence of child malnutrition around the world[8] (Table 4).

Region:	Wasting	Stunting
Africa	10.1%	41.1%
Latin America	2.7%	33.8%
Asia	18.8%	47.0%
Eastern Mediterranean	5.8%	38.6%

Table 4. *Median prevalences of wasting and stunting in National Surveys (1).*

In another review focusing to African countries, median prevalence rates of the three types of malnutrition are given by age[9] (Table 5).
In comparison to these international data, children of Sikasso have a comparable level of stunting, but a more important prevalence of wasting.
As it has been generally observed, prevalence of wasting is greatest between 1 and 2 years of age and falls markedly later on, whereas prevalence of stunting increases over time up to the age of 2 or 3 years and then shows a tendency to level off[9,10]. Prevalence of stunting was threefold higher than wasting in children of Sikasso; this common finding suggests a gradual development of stunting for a longer period than for wasting malnutrition[11].
A disturbing finding in this study is the observed increase in the prevalence of wasting over time, during the five years of the follow-up. No obvious explanations seems to account for this finding. *Ageing* of the sample, due to the fact that the same families were followed-up, would be expected to lead the participating families to consult more often to the preventive services and to possibly decrease the risk of malnutrition of their children over time. If this increase is not due to some other biases, it could be the consequence of a deterioration in the general economic situation of the families.
The methodology adopted for the analyses presented here does yet not make use of the longitudinal dimension of this study. Because of the cross-sectional nature of the data, is was not possible to disentangle the effects of the various socio-economic variables. On the whole, our results confirm that stunting is strongly associated with socio-economic factors. These factors can be divided in two categories: education, and wealth. Both groups of factors appear to have strong and partly independent effect on stunting.
Education has been shown in other studies to be associated with stunting, but not so much with wasting. For instance in southern Brazil, a strong association between stunting malnutrition in children and the number of years of schooling of their parents has been observed[12]. As in Sikasso, the association was much weaker with wasting malnutrition. In other studies as well, the effect of parental education seem to be stronger during childhood than during infancy[13].
On the other hand, family income is a strong determinant of stunting

Age (year)	Underweight	Stunting	Wasting
0	11	24	4
1	31	42	9
2	27	40	4
3	21	42	3
4	18	39	3

Table 5. *Median prevalences of wasting and stunting in National Surveys (2).*

malnutrition. Although income and education are strongly correlated, both seem to contribute partly independently to malnutrition.
In a study in Jamaica, boys who had been hospitalised with severe malnutrition (marasmus or kwashiorkor) during their first two years of life were more likely to come from poorly built and equipped houses, than control children[14].
In rural northern Nigeria, children aged 3–48 months living in households with unprotected source of water had a higher prevalence of wasting malnutrition, but not of stunting, than children with adequate supplies of drinkable water[15].
In contrast a study in Brazil showed that stunting, and not wasting, was commoner in households without piped water[12].
For Gorstein there seems to be a direct relationship between stunting and poor socio-economic status which gives rise to inadequate living conditions not conductive to attaining optimal health[16].

Zusammenfassung

Unterernährung bei Kindern in Sikasso (Mali): Prävalenz und sozioökonomische Determinanten

Situation: *Der schlechte Ernährungszustand von Kindern in vielen afrikanischen Ländern ist eines der wesentlichen Gesundheitsproblemen. Dies ist auch in Sikasso (Mali) der Fall, obwohl diese Region geographisch günstig situiert ist.*
Methode: *Dieser Artikel schildert eine Erhebung, in welcher während fünf Jahren jährlich der Ernährungszustand von 491 Familien erfasst worden ist. Die Determinanten des Ernährungszustandes der Kinder dieser Familien wurden mittels logistischer Regressionanalyse erhoben.*
Resultate: *Es zeigte sich, dass die Prävalenz der chronischen Ernährungsprobleme um die 25% liegt. Eine Assoziation von Ausbildungsgrad der Eltern und ökonomischem Status der Familien liess sich nachweisen. Die Prävalenz akuter Ernährungsprobleme liegt um die 12%, was sehr hoch ist; letztere nahm über die Jahre zu; es bestand keine Korrelation zu sozio-ökonomischen Faktoren.*

Résumé

Prévalence et déterminants socio-économiques de la malnutrition chez les enfants de Sikasso (Mali)

Situation: *La malnutrition des enfants est un problème majeur de santé publique dans de nombreux pays africains. Malgré une situation géographique relativement favorable, la prévalence de la malnutrition est élevée dans la région de Sikasso (Mali).*
Méthode: *Enquête annuelle répétée au cours d'une période de 5 ans, sur un échantillon de 491 familles. Les déterminants de la malnutrition sont analysés par régression logistique.*
Résultats: *La prévalence de la malnutrition chronique se situe autour de 25%, tandis que celle de la malnutrition aiguë autour de 12%. Ce dernier pourcentage est très élevé et a augmenté au cours des dernières années. Aucune association importante n'a été observée avec les facteurs socio-économiques en ce qui concerne la malnutrition aiguë. Au contraire, la malnutrition chronique est fortement associée avec le niveau d'éducation des parents, ainsi qu'avec l'aisance materielle de la famille.*

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